MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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Dr. LEE, President, in the Chair.

Lieut. Allen Young, R.N., Riversdale, Twickenham, was balloted for and duly elected a Fellow of the Society.

A Last Letter from Capt. W. S. Jacob.

(*Communicated by Prof. C. Piazzi Smyth*).

"Having enjoyed the privilege," writes Prof. Smyth, "of receiving frequent letters from my estimable friend, Captain W. S. Jacob, during the whole of his previous career in India as an official astronomer, I hailed with exceeding delight, during last September, the arrival of a first letter, written on his once again returning to the land of his adoption and youth; now as a private astronomer, but with judgment matured, intellect strengthened, his own settled problems to work out, and a far more powerful astronomical instrument than he had ever had an opportunity of observing with before.

"But that first letter was destined also to be his last, for within a week of closing it, he was no more of *this* world. He had served the government previously, but too faithfully, first in a military capacity, and afterwards in the Madras Observatory; and had, as the result has proved, too nearly consumed for them his physical vital energies, while his mind was still active and dominant as ever.

"Capt. Jacob's letters, and his manner too, were never of a demonstrative character; but there was always a quiet worth about them, a calmness of view, sobriety of description, and easy introduction of numerical data, which rendered them of remarkable interest, and occasionally of extreme importance with reference to many scientific questions. These characteristics are all so well marked in his last letter, that I have thought for that reason, as well as because it is the last letter of a good and learned man, that the members of the Royal Astronomical Society might be interested in seeing it, recording it, and judging for themselves. It runs thus,—

"'*Ship Herefordshire, 25th July*, 1862.

"'My dear Smyth,

"'As we approach Bombay I begin a letter to have it ready to despatch on arrival, as I may not have time to write much then. We have had a tolerably pleasant voyage on the whole, the ship being well found and commanded, the party of passengers not too large, so as to incommode each other, and all having pulled pretty well together, so that there have been no quarrels, though a long sea-voyage seldom passes without them. Our freedom from them I attribute, in part, to the absence of *cards*, which often prove a fertile source of dispute.

"'I have been able to do but little in the way of work on the voyage; much less than I expected; there were perpetual interruptions, and though we have met with little or no very severe weather, there has been plenty of it sufficiently rough to prevent our settling to any quiet occupation, and especially the use of the microscope, with which I had hoped to do something. But in this I have quite failed. In the few attempts I have made, I did not succeed in finding any organism in the water at all. How to account for this is a puzzle to me; but I have also remarked that there has been throughout the voyage far less phosphorescence at night, than I remember on any former occasion; on many nights none whatever.

"'On the other leaf are a few memorandums which may interest you; you can make any use of them you please. The S.E. Trade has been irregular and squally on both sides of Africa: on *this* side it has occasionally blown for some hours from E.N.E., or thereabouts. So there have been anomalies in the atmosphere as well as the ocean.

"'*August 7th.* The same remarks will apply to the end of our voyage; when this was commenced we were expecting to reach Bombay in about a week, the passage from the Line being generally pretty rapid at this season, but instead of finding the S.W. monsoon at or near the Line, we met with light baffling winds from S., W., and even N.W., as far at lat. 10° N. For the last three days we have had the monsoon wind, but very little S. of W. We hope to anchor this after-

noon. All well, and in pretty good spirits, though we have been suffering latterly from heat more than I should have expected, the highest temperature having been 85°, but the light winds made it more oppressive. With our kind remembrances to ———,

"'Believe me,

"'Yours very truly,

"'W. S. Jacob.'

"11th August. Anchored on the 7th, at 2^h P.M. Leaving for Poona to-morrow morning. All well!

"*Zodiacal Light.*

May 17th, at 8^h P.M., in lat. 21° 1′ N. and long. 23° 20′ W.

Zod. light very bright, extending nearly to *Præsepe*.

	h	m		°	′
·.· apex in R.A.	8	31	and Decl. +	20	30
and Sun in R.A.	3	37	and Decl. +	19	25

May 26th, at $7^h\ 30^m$ P.M., in lat. 4° 45′ N. and long. 21° 20′ W.

Zod. light reaches nearly to ε *Leonis*.

	h	m		°	′
·.· apex in R.A.	9	35	and Decl. +	24	30
and Sun in R.A.	4	13	and Decl. +	21	12

June 11th, $16^h\ 0^m$, in lat. 14° 44′ S. and long. 32° 15′ W.

Zod. light extends nearly to *Mars*.

	h	m		°	′
·.· apex in R.A.	23	13	and Decl. −	8	5
and Sun in R.A.	5	21	and Decl. +	23	9

June 16th, $7^h\ 0^m$, in lat. 26° 30′ S. and long. 34° 0′ W.

Zod. light extends to a little beyond *Regulus*; axis points nearly to α *Virginis*.

	h	m		°	′
·.· apex in R.A.	10	5	and Decl. +	12	30
and Sun in R.A.	5	39	and Decl. +	23	22

June 21st, $7^h\ 0^m$, in lat. 31° 53′ S. and long. 24° 55′ W.

Zod. light reaches nearly to *Saturn*, a little S.W.

	h	m		°	′
·.· apex in R.A.	11	16	and Decl. +	7	0
and Sun in R.A.	6	0	and Decl. +	23	27

July 16th, $6^h\ 40^m$, in lat. 29° 52′ S. and long. 55° 19′ E.

Zod. light seen along with twilight. At $7^h\ 0^m$ the vertex extends to half way between γ and α *Virginis*. The light is much paler than the brighter portion of the Milky Way.

	h	m		°	′
∴ apex in R.A.	12	57	and Decl. —	5	34
and Sun in R.A.	7	43	and Decl. +	21	20

July 17th, $7^h\ 0^m$, in lat. 28° 11′ S. and long. 57° 40′ E.

Sky hazy; the Zod. light is ill defined, but seems to reach a point about $\frac{1}{3}$ of the way from *Spica* towards δ *Virginis*.

	h	m		°	′
∴ apex in R.A.	13	5	and Decl. —	7	15
and Sun in R.A.	7	47	and Decl. +	21	10

July 22d, $7^h\ 30^m$, in lat. 16° 2′ S. and long. 62° 23′ E.

Sky hazy; Zod. light very indistinct, extremity somewhere about *Spica*.

	h	m		°	′
∴ apex in R.A.	13	18	and Decl. —	10	26
and Sun in R.A.	8	7	and Decl. +	20	15

July 30th, $16^h\ 40^m$, in lat. 5° 5′ S. and long. 63° 20′ E.

Zod. light bright; extremity nearly two degrees north of α *Tauri*, noted while *Venus* was behind a thick cloud.

	h	m		°	′
∴ apex in R.A.	4	28	and Decl. +	18	15
and Sun in R.A.	8	39	and Decl. +	18	30

" *Other Phenomena.*

" May 21. In lat. 12° 20′ N., long. 25° 0′ W., η *Argus* is almost lost in the nebula — quite so to the naked eye. In binocular, it looks a little brighter than ε *Crucis*, but far below δ.

" June 11. Lunar eclipse: when totally immersed, the Moon was of a dull copper colour, with a silvery edge at the part last immersed.

" July 16. In lat. 29° 45′ S., and long. 55° 25′ E., a large meteor seen at $7^h\ 50^m$, about twice as bright as *Venus*, passing obliquely downwards to the left, a little below *Corona Borealis*. It disappeared and reappeared several times behind small clouds.

" July 17. η *Argus* is now scarcely so bright as ε *Crucis*.

" July 29. Many small meteors at about 15^h, most of them directed towards a point between *Polaris* and *Capella*, rather

nearer *Polaris!* One, brighter, crosses *Cygnus* from *Cassiopeia.*

"July 30. Many small meteors in various directions between 8^h and 9^h, and again about 16^h 30^m."

Thus closes Capt. W. S. Jacob's last letter to me; wherein, the meteor of July 16th, with its notes of proof of a minimum distance; and the Zodiacal Light of July 30th, with its example of profiting by an accident, to eliminate a dangerous interference with the sort of observation he was engaged on, illustrate most truly the able observer and intelligent mind. I would also, and more particularly, beg to call attention to the extremely anomalous condition which the writer describes, as prevailing both in the sea and atmosphere; the latter evidenced in the perversion of both trade-winds and monsoons: the whole forming a most independent testimony to Sir John Herschel's opinion recently expressed, in the *Memoirs of the Manchester Philosophical Society;* to the effect, that the climate of the whole Earth has been experiencing, for the last two and three years, a remarkable disturbance from a cosmical cause, which he places in the Sun, and traces, first in its direct action on the Southern hemisphere, and then indirect action on the Northern.

In the section of the Zodiacal Light I have added to each observation, in parentheses, a note of the concluded Right Ascension and Declination of the apex of the light, as well as of the Sun, at the time, to facilitate deductions; and amongst the additional phenomena, have only to allude to the striking terms in which my deceased friend describes the decadence of *η Argus.* When I left the Southern hemisphere, in 1845, this star was brighter than any in the Northern hemisphere, and was the third brightest in the Southern, being transcended only by *Sirius* and *Canopus*, if, indeed, the latter was superior. It was then, without doubt, brighter than when Sir John Herschel left the Cape in 1838; but it had increased so much during his stay, that that great astronomer remarked, in a conversation there can now be hardly any blame in reporting, "that he was glad he had mapped down the nebula around *η Argus* during the earlier part of his visit, for that now (in 1837) the star was so bright as to have nearly extinguished the nebula," or words to that general effect. In the year 1862, however, behold Capt. Jacob beginning to describe *η Argus* as, in its turn, "almost lost in the nebula"—a remarkable inversion of the former particulars.

Observations of the Horizontal Refraction of the Sun.

By A. Lang, Esq.

The observations were made on the rising, from the horizon of the Sea, of the Sun's upper or lower limb, or both combined, so as to determine the exact moment of the rising of his centre, and from that the exactly computed zenith distance at that moment, for the purpose of obtaining the refraction, through comparison with the actual zenith distance of the horizon of the Sea, as measured and determined at the place of observation. The place of observation, "my Observatory" in the Island of St. Croix, in lat. 17° 44′ 32″ N., long. 64° 41′ W. from Greenwich; height of the axis of my Altitude and Azimuth circle (Troughton) above the level of the sea, 440 English feet, most carefully measured in every way (tube only a few inches); angle of depression of horizon of the Sea, as determined by the instruments, I have never found less than 20′ 52″, and never beyond 21′, and the last very rarely. I have therefore assumed the angle of depression for the following observations as 20′ 56″, or zenith distance 90° 20′ 56″; the height of my eye in observing the Sun being always at the same height above the Sea-level as the axis of the Circle, but in an adjoining apartment, near my mean-time clock, that I might hear and count the seconds. Telescope used, an excellent 44-inch refractor, using a magnifying power of 42, always previously fixed on the spot where the Sun would rise.

	Zenith Distance of Sun's Centre. By Computation.	Zenith Distance of Sun's Centre. Actual Observation.	Refraction and Parallax.	Barom. Ins. Pts.	Therm. Fahr.
	° ′ ″	° ′ ″	′ ″		°
1831, May 3	90 53 25	90 20 56	32 29	29·63	76
June 20	52 44·8	,,	31 48·8	·70	73
1832, June 5	52 58·7	,,	32 2·7	,,	79·5
Oct. 27*	54 4·5	,,	33 8·5	,,	,,
1833, July 31	53 11·5	,,	32 15·5	·63	79
Oct. 31	53 6·4	,,	32 10·4	·62	77·5
Nov. 1	52 50·5	,,	31 54·5	·53	78
1834, May 3	53 11·1	,,	32 15·1	·69	78
July 11	52 57·8	,,	32 1·8	·60	79
Oct. 25	53 6·9	,,	32 10·9	·62	79
1837, July 30	53 6·9	,,	32 10·9	·67	78
1839, May 17†	90 53 1	,,	32 5	29·635	77

* I am not satisfied with this observation.

† The observation of May 17, 1839, which I have carefully computed, should be more correctly stated 90°53′14″·82 (−90°20′56″ = 32′18″·82). It attracted my notice, as the time was exactly determined by a transit immediately afterwards. It is singular it should so exactly agree with the mean of 17 observations.

	Zenith Distance of the Sun's Centre. By Computation.	Actual Observation.	Refraction and Parallax.	Barom. Ins. Pts.	Therm. Fahr.
	° ′ ″	° ′ ″	′ ″		°
1840, May 11	90 53 47·7	90 20 56	32 51·7	29·64	77
1844, July 30	52 56·8	,,	32 0·8	·57	79
1846, May 13	53 42·4	,,	32 46·4	·61	79
17	53 37·6	,,	32 41·6	·55	78
1848, Feb. 17	90 53 22·7	,,	32 26·7	·55	70
	17)905 12·8		549 20·3	15)92·85	16)1240
	90 53 10·84	90 20·56	32 18·84	29·619	77·5
1857, Oct. 27*	90 53 25	,,	32 29	29·547	77·5
30	53 19	,,	32 23	·602	78
Nov. 1	53 22·6	,,	32 26·6	·593	78·6

The altitude of my Observatory above the level of the sea, 440 English feet, causes a depression in the barometer of 0·455 inch.

From my station, the rising of the Sun from the horizon of the sea can only be seen in May, June, July, part of October, November, and February. The setting of the Sun into the horizon of the sea, not at all. Moreover I have sometimes every morning, for six weeks running, watched, disappointed, to get an observation on his rising, in consequence of dense low clouds of cumuli at horizon. To this day I have not obtained a single observation this year. So it is not so easy a matter as may be imagined.

St. Croix, 11th July, 1862.

On the Practicability of observing the Occultation of Stars by the Moon at Sea. By David Smith, Esq.

The author, in his communication addressed to the President and Council of the Society, writes as follows:—

It is not without some degree of hesitation that I take the liberty of forwarding you the results of my own experience as regards the practicability of observing Occultations of Stars at sea. The desire I feel that this most invaluable method for determining the Longitude may come into more general use amongst Naval men will, I trust, be a sufficient apology for my addressing you.

The method, as far as I can ascertain, has been, but with few exceptions, wholly neglected at sea: this has, no doubt, arisen from a supposition that the motion of a vessel would

* "An admirable observation" is added to the observation in my Journal.

prevent using a telescope of sufficient power to observe the phenomena, as the stars most frequently occulted are small. Another reason may be, that a previous knowledge of the star or its relative position to the larger stars is requisite.

With respect to the objection on account of the vessel's motion, I have only to state that except when a ship is very uneasy and laboursome, that stars up to the third magnitude can easily be observed disappearing or reappearing at the Moon's dark limb; and that in smooth water, and the Moon not nearer than three days from the opposition, stars between the fourth and fifth magnitude can be observed with great precision.

As regards the power of the telescope employed, all that is necessary is a good ship's glass, such as are usually sold for 3*l.* or 4*l.* With instruments of this description I have observed ten occultations, which have yielded unexceptionable results. They stand as under:—

Disappearance of	✱	Regulus on the Moon's dark limb.	
,,	✱	*b* Ophiuchi	,, ,,
,,	✱	h^2 Sagittarii	,, ,,
,,		Saturn	,, ,,
,,	✱	φ Sagittarii	,, ,,
,,	✱	Antares on the Moon's bright limb.	

Reappearance of	✱	Antares on the Moon's dark limb.	
,,	✱	η Piscium	,, ,,
,,	✱	η Tauri	,, ,,
,,	✱	27 Tauri	,, ,,

The two last-named stars were observed on the same night, and the results agreed to within two seconds of time.

In the case of the star h^2 *Sagittarii*, the star seemed to advance upon the Moon's disk before disappearance.

The disappearance of *Antares* on the Moon's bright limb gave a very satisfactory result, as was verified on our arrival at Colombo, Ceylon, some ten days after.

I may add that I have found Captain Shadwell's Tables (for finding the approximate times of beginning and ending) of great assistance, being concise and easy of application, and invaluable for finding the time of reappearance.

In the annexed papers I have given the calculation of the longitude by the Occultations of η *Piscium*, η *Tauri*, and 27 *Tauri*.

I may also state that I have observed the termination of two Solar Eclipses at sea. The resulting longitudes were very exact. One happened two days after leaving port, and the

other in sight of the Island of Basilan, near Mindanao; so that the chronometer's errors were well known.

By means of the Eclipse of the Sun and the Occultation of the star *η Piscium*, carried on by a very steady chronometer, I have during my last voyage been enabled to check the Longitudes of several most important points in the Eastern Archipelago.

Lavender Wharf, Rotherhithe, S. E.,
July 24th, 1862.

The following is one of the three calculated Occultations above referred to.

Occultation of ∗ η Piscium by the Moon.

On board the ship Marchioness, of Londonderry, July 1861, in the Java Sea; latitude 4° 49′·3 south; longitude by account 114° 55′ east. I observed the reappearance of the star *η Piscium* on the Moon's dark limb to take place on July 28th, $15^h\ 25^m\ 8^s$ apparent time at ship. A chronometer showed at the same time, $7^h\ 48^m\ 46^s$, its assumed error on Greenwich Mean Time being $2^m\ 50^s$ slow. Required the longitude of the ship, and the chronometer's error on Greenwich Mean Time by this observation.

	h	m	s
Time of emersion by chronometer, July 28th	7	48	46
Chronometer's assumed error, slow..... =	+ 2	50	
Greenwich date of observation ..... =	7	51	36

at which time we have the Sun's Right Ascension $=8^h\ 31^m\ 59^s$, Moon's Declination 14° 21′ N., Moon's Equatoreal Horizontal Parallax $=54'\ 16''{\cdot}0$, Moon's Semidiameter $=14'\ 49''{\cdot}2$, the Star's Right Ascension $1^h 24^m 6^s{\cdot}17$, Star's Declination $=14°\ 37'\ 58''{\cdot}6$ N., Reduction of Latitude $-1'\ 55''$, log. radius of the Earth at the place $=9{\cdot}99999$.

	h	m	s		°	′	
Sun's right ascension..... =	8	31	59				
Apparent time ..... =	15	25	8				
Right ascension of meridian =	23	57	7	Latitude..... =	4	49	·3 S.
Star's right ascension ..... =	1	24	6	Reduct. = −			1·9
Star's hour-angle in time E. =	1	26	59	Geocentric lat. =	4	47	·4 S.
h = ,, in arc =	21	44	45				

☽'s equat. hor. par. log. 3·51268
Log. radius of Earth ... 9·99999

Log. reduced parallax	3·51267		3·51267	= 3·51267
Latitude, cosine	9·99848	sine.....	8·92161	cosine ... = 9·99848
✳'s hour-angle h, sine	9·56876	✳'s δ, cosine	9·98568	✳'s δ, sine = 9·40248
p =	3·07991	K = 263″·0 =	2·41996	(h), cosine = 9·96846
☽'s declination, cos	9·98623			K′ = −762″·2 = 2·88209
	3·09368	K = −263″·0		
Constant logarithm.....	7·92082	K′ = −762·2		

Cor. of ✳'s hour-ang. = −10′·34 = 1·01450 K + K′ = −1025·2 = cor. ✳'s decl. = 17′5″·2

✳'s hour-angle	h = 21° 44′·75	✳'s declination	= 14h 37m 58s·6 N.
Correction as above	− 10·34	K + K′ − corr.	= − 17 5·2
✳'s hour-angle corrd.	(h) = 21 34·41	✳'s decl. corrd.	= 14 20 53·4 N.

Computation of the first part of the Moon's Parallax in Right Ascension:—

Log p as in the preceding part = 3·07991
✳'s corrected declination cos = 9·98623
3·09368
Constant logarithm = 8·82391

First part of ☽'s par. rt. ascen. log = 1·91759 = 82ˢ·72 or −1ᵐ 22ˢ·72

The ☽'s declination at the Greenwich date (corrected for 2ˢ difference) is 14° 20′ 58″·7 N.

Computation of the second part of the Moon's Parallax in Right Ascension:—

✳'s decl. corrected	14°	20′	53″·4 N.	mean = β = 14° 20′ 56″ N.
☽'s declination ...	14	20	58·7 N.	
Diff. =		5·3		✳ south of the ☽.
☽'s semidiameter =	14	49·2		
Sum =	14	54·5 =	894″·5	log. = 2·95158
Diff. =	14	43·9 =	883·9	log. = 2·94640
β =	14	20	56	cosec.² = 0·02753
				2) 5·92551
				2·96275
			Log 15 constant =	1·17609

Second part of ☽'s par. right ascen. = + 61ˢ·19 log 1·78666

		h	m	s
✱'s right ascension		1	24	6·17
Part 1st corr.	—		1	22·72
		1	22	43·45
Second part	+		1	1·19
☽'s right ascension =		1	23	44·64
,, at 7^h =		1	22	6·31
,, at 8^h =		1	24	0·57

diff. 98·33 log..... = 1·992686

diff. 114·26 log (ar. comp.) 7·942106

36″·00 constant log 3·556302

log = 3·491094

Correction in time = + 3098ˢ·1

$+51^m38^s.1$

	h	m	s
Greenwich time	7	0	0·0
M.T. at Greenwich =	7	51	38·1
Equation of time = —		6	10·1
App. time at Green. =	7	45	28
App. time at ship =	15	25	8
Long. in time =	7	39	40

Longitude in arc = 114° 55′ 0″ E.

	h	m	s
	7	51	38·1
Chronometer showed	7	48	46·0
Chron. slow, G.M.T. =		2	52·1

N.B. An error of 2 miles in the latitude does not affect the result, an error of 10 seconds in the hour-angle of the star or apparent time makes a difference of only $4^s.6$.

The latitude had been deduced from the meridian altitude of ✱ *Schedar*, which happened soon after the occultation, and reduced to that time by the D.R. This was also checked from the preceding and following days' latitudes by the D.R. Allowing for the current, the two results agreed within half a mile.

The apparent time was deduced from four sets of observations of stars E. and W. of the meridian, taken with two different instruments, viz. two sets of ✱ *Aldebaran* E. and two sets by ✱ *Altair* W. These were again checked by observations of the Sun for time after sunrise, and agreed very closely.

Six hours after observing the occultation, we were on the meridian of the east end of the Island of Arentes, in the Java Sea. I then took sight of the Sun and Moon for time, the Sun being east and the Moon west of the meridian. The results showed the chronometer to be

	h	m	s
	7	41	23·5 slow of the mean time of the place,
and the chron.-error being —		2	52·5 slow.
	7	38	31

or the longitude of the east point of Arentes in arc = 114° 37′ 45″ E. of Greenwich.

This agrees nearly with Lieut. Raper's position: he gives the centre of the island $=114^{\circ}\ 37'$. The island extends about three miles E. and W.

Forty-seven lunar distances from the Sun, viz. 31 W. and 16 E., gave the chronometer an error of $2^{m}\ 51^{s}$ slow at the time of occultation, which would assign nearly the same value for the longitude of the island as given above.

The chronometer had a steady rate of $1^{s}\cdot 6$, losing for about seventy days.

On the Variable Star R *Vulpeculæ.* By G. Knott, Esq.

From a comparison of my own observations with Mr. Pogson's useful Ephemeris, I had been led to suspect some irregularity in the period of this star, and in a short paper, which was printed in the last volume of the *Monthly Notices*, I communicated my suspicions to the Astronomical Society. The paper appears to have come under the notice of Dr. Winnecke of Pulkowa, who, by his observations and researches, may almost be said to have made the star his own, and in a letter to the Rev. R. Main (*Monthly Notices*, vol. xxii. No. 8), adverting to the subject he remarks that he was afraid that an error of transcription had crept into the elements he communicated to Mr. Pogson, and proceeds to give his definitive epoch and period founded on "seven maxima, observed in the course of three years, with reference to Piazzi's estimations of magnitude in August 1803," together with an Ephemeris for the years 1861, 1862. My own observations of two maxima present so fair an accordance with Dr Winnecke's predictions, that I venture to submit them to the Society, in the hope that they may possess some interest. My final results are as follow:

Observed maxima of R *Vulpeculæ*, 1861, December 30·5, mag. = 8·7. 1862, October 4, mag. = 8·2, being later than the calculated dates by $3\frac{1}{2}$ and 4 days respectively, a difference which may *possibly* be due to *personal equation*. The period deduced from these observations, viz. 138·75 days, presents also a very satisfactory agreement with that given by Dr. Winnecke, and I think we may fairly infer that R *Vulpeculæ* belongs to the class of regular variables.

Woodcroft Observatory, Cuckfield,
November 17th, 1862.

Description of a New mode of obtaining the Value of the Divisions of a Transit Level. By Capt. W. Noble.

I have recently been occupied in re-determining the value of the divisions of my Transit Level, by a method which, while

it involves no new principle, is, I believe, in detail perfectly original.

The Level, the value of whose divisions was to be determined, was in the first place lashed securely to the declination circle of my Equatoreal. The micrometer having been screwed into the eye end of the telescope, the wires were separated by some known number of seconds of arc. The instrument being now firmly clamped in the meridian, the telescope was so adjusted that a star not very far from the equator should, during its transit, run along and be threaded by the *top* wire of the micrometer. Just before the star entered the field the level was carefully read. As the star approached the middle of the field the telescope was depressed by means of the tangent screw of the declination circle, until the star ran along the *bottom* wire of the micrometer, whereupon the level was again read immediately. The number of seconds of arc through which the telescope, declination circle, and level, had been moved, was of course that of the interval between the micrometer wires, and this, divided by the number of divisions passed over by the level bubble, gave the value of one division.

The possessor of a large meridian circle would doubtless find that the ordinary mode of lashing his level to this circle and of reading the arc passed over by means of the circle microscopes, would be more accurate and expeditious; but to those who like myself possess only an Equatoreal, I would commend my method as susceptible of very considerable precision.

I may, in conclusion, mention merely as a fact, without attempting to account for it, that I invariably obtained a larger value for the divisions of the level scale from daylight observations, than I did from those made at night.

Forest Lodge, Maresfield, Sussex,
November 12th, 1862.

Results of the Meridional Observations of Small Planets; Occultations of Stars by the Moon; and Occultation of Jupiter's Second Satellites; observed at the Royal Observatory, Greenwich, in October and November, 1862.

(*Communicated by the Astronomer Royal.*)

Themis (24).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1862, Oct. 29 13 3 52·2	3 36 15·10	70 21 4·09
Nov. 27 10 46 17·8	3 12 38·23	71 40 47·37

Iris (7).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1862, Oct. 3 9 57 43·1	22 47 5·02	86 16 41·77
9 9 31 39·9	22 44 36·92	86 54 20·02
10 9 27 26·6	22 44 19·41	87 0 17·11
11 9 23 14·9	22 44 3·59	87 6 8·46
14 9 10 53·1	22 43 29·46	87 22 56·42
16 9 2 49·2	22 43 17·35	87 33 26·04
18 8 54 54·2	22 43 14·12	87 43 17·15
24 8 32 1·9	22 43 57·37	88 8 53·89
29 8 13 58·5	22 45 33·81	88 24 59·68
31 8 7 0·2	22 46 27·44	88 30 1·89
Nov. 3 7 56 48·3	22 48 3·55	88 35 58·61
10 7 34 9·2	22 52 56·64	88 42 33·16
12 7 27 57·7	22 54 37·17	88 12 34·85
17 7 12 59·5	22 59 19·34	88 38 56·13

Pomona (32).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1862, Oct. 3 11 29 51·4	0 19 28·51	82 54 34·44
18 10 19 41·1	0 8 14·99	84 39 36·75
20 10 10 33·4	0 6 58·84	84 52 46·23

Aglaia (47).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1862, Oct. 3 11 55 31·7	0 45 12·98	83 57 44·08
24 10 16 19·6	0 28 32·23	85 4 20·05

Ausonia (68).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1862, Oct. 14 8 20 7·1	21 52 35·07	101 28 58·68
16 8 12 37·8	21 52 57·65	101 22 50·13

All the observations of N.P.D. have been corrected for refraction and parallax.

Occultations of Stars by the Moon.

Day of Observation. 1862.	Phenomenon.	Moon's Limb.	Mean Solar Time.	Observer.
			h m s	
Oct. 11	κ' Tauri, disapp.	Bright	13 32 56·2	E.
11	κ' Tauri, reapp.	Dark	14 54 18·6	M.D.

The initials E. and M. D. are respectively those of Mr. Ellis and Mr. Dolman.

On Nov. 24, Mr. Roberts observed the Reappearance after Occultation of *Jupiter's* Second Satellite. The last contact took place at $18^h\ 27^m\ 20^s{\cdot}4$ G.M.T.

The *Ann Arbor Astronomical Notices*, No. 28, contains a paper by Truman Henry Safford, Assistant at the Observatory of Harvard College, on the Proper Motion of *Sirius* in Declination.

The author in the first place refers to a paper by Dr. C. A. F. Peters, in the *Astronomische Nachrichten*, Nos. 745, 746, 747, on the Proper Motion of *Sirius* in Right Ascension; in which, by first comparing the observed Right Ascensions of α and β *Orionis* in different years with the tabulated Right Ascensions in the *Tabulæ Regiomontanæ*, and thence inferring the corrections to be made to observed places (a process which amounts to the same as supposing that the tabulated Right Ascensions are correct, or subject only to constant error), and applying those corrections to the observed Right Ascensions of *Sirius*, and comparing the corrected observed Right Ascensions of *Sirius* with the tabulated Right Ascensions of *Sirius* in the *Tabulæ Regiomontanæ*, a series of irregularities in the Right Ascensions of *Sirius* are found, which are numerically represented by the following hypothesis. That *Sirius* revolves in an elliptic orbit, on the law of gravitation, round an invisible companion; the time of passing the lower apse being the year 1791·431, the mean yearly motion $7^\circ{\cdot}1865$ (or periodic time 50·01 years), and the excentricity 0·7994: so that, putting u for the excentric anomaly at any time, the mean anomaly or $7^\circ{\cdot}1865\ (t - 1791{\cdot}431)$ will be equal to $u - 0{\cdot}7994 \cdot \sin u$ (from which equation u is to be found); and the correction to the tabular place of *Sirius* will be

$$0^s{\cdot}127 + 0^s{\cdot}00050 \cdot (t - 1800) + 0^s{\cdot}171 \cdot \sin (u + 77^\circ\ 41').$$

where $0^s{\cdot}127$ is a constant correction to the tabular Right Ascension, $0^s{\cdot}00050$ is a correction to the annual variation, and $0^s{\cdot}171$ and $77^\circ\ 44'$ are constants depending on the magnitude of the major axis, its position, the position of the line of nodes of the orbit on the celestial sphere, and the inclination of the orbit to the celestial sphere.

The author then proceeds to treat the irregularities in the Declination of *Sirius* in the same manner. He uses the observations of Bradley (omits those of Maskelyne and Pond before 1822, because the thermometer coefficient is erroneous and he has not re-reduced the observations), uses Bessel 1820, Pond 1822, Struve 1824, Argelander 1830, Taylor 1832·5, Henderson (Cape) 1833, Maclear (Cape) 1834, Airy (Cam-

bridge), Henderson (Edinburgh), Airy (12 year), Airy (6 year), Airy (later results), Busch (*Astr. Nach.* No. 422), Bond 1843, Moesta. Piazzi is omitted, as not sufficiently accurate. The author supports the exactitude of Bradley's result by comparison with Lacaille (1750) and Mayer (1756).

The stars of comparison employed are *α Virginis*, *α² Libræ*, *α Scorpii*, *α² Capricorni*. The tabular places are altered, when necessary, so as to introduce the constant of nutation 9″·22, instead of 8″·98 as in the *Tabulæ Regiomontanæ*, or 9″·65 as in the *Fundamenta Astronomiæ*.

The resulting irregularities in the declination of *Sirius*, now to be explained, are the following:—

1755	−0″·70	1833	−1″·48	1843	+1″·11
1820	−0″·40	1834 (A)	−2″·38	1844·5	+1″·86
1822	−1″·48	1834 (M)	−1″·71	1850·8	+2″·06
1824	−1″·63	1837	−0″·76	1855	+0″·82
1830	−0″·96	1838·5 (A)	−0″·39	1856·5	+1″·53
1832·5	−1″·68	1838·5 (B)	−0″·42		

No correction to mean places and mean annual variation destroys the periodicity of those terms, or even reduces the sum of squares of errors in a greater degree than from 33 to 25.

The author then proceeds to try the effect of introducing the same hypothesis as that found by M. Peters from the Right Ascensions; adopting the supposition of elliptic orbit, using the same time of passage of apse and the same excentricity, and determining the two constants still undetermined from comparison of the irregularities with the following formula:—

$$w + x\,(t - 1800) + y\,.\,\sin u + z\,.\,\cos u,$$

and finally obtains

$$0''{\cdot}56 + 0''{\cdot}0202\,(t - 1800) + 1''{\cdot}47\,.\,\sin u + 0''{\cdot}51\,.\,\cos u.$$

By introduction of this formula, the sum of squares of errors is reduced to one-eighth part of the least possible amount on the hypothesis of uniform motion.

It would seem, therefore, that great probability attaches to the hypothesis that, in the system of which *Sirius* is the only visible part, there is a large invisible mass present.

The greatest defect in the series of observations here treated is the lacuna between 1755 and 1820. A large part of this, perhaps, can never be supplied. The unfortunate introduction of Graham's quadrant destroys our confidence in the greater part of Bradley's results, and in Olufsen's corrections for the quadrant in subsequent years (which depend on Bradley). If, however, Bradley's later observations could be

plausibly corrected, the observations of Maskelyne, treated by the method of comparison-stars, would give good instrumental results. No uncertainty, such as is produced by wearing of centre-work of the quadrant, attaches to Piazzi's or Pond's observations.

The correction of the refractions would be no very great work.

On the whole, we could wish that the able author of this paper could be induced to give to it all the completeness which existing materials can enable him to give. G. B. A.

On the Forms of Lenses proper for the Negative Eye-pieces of Telescopes. By G. B. Airy, Esq., Astronomer Royal.

In the *Monthly Notices* for June and November last, there are discussions on the forms of lenses proper for the Negative Eye-piece. Perhaps I shall not do wrong in stating to the Society that as long ago as the year 1827 I made a most elaborate investigation of the properties of Eye-pieces as depending on the curvatures of their surfaces. The paper is entitled "On the Spherical Aberration of the Eye-pieces of Telescopes," and is printed in the *Transactions of the Cambridge Philosophical Society*, vol. iii. This paper had been preceded by one "On the Chromatic Aberration of the Eye-pieces of Telescopes," from which I had been able to infer the proportions of the focal lengths and intervals of the lenses, which (independently of their curvatures) destroy colour at the sides of the field, using but one kind of glass; and had selected some of these as examples to which the formulæ for Spherical Aberration were to be applied. One of these is the Huyghenian Eye-piece, with the following very common proportions:— Focal length of first lens or field-glass = 3 M; focal length of second lens or eye-glass = M; interval between the two lenses = 2 M.

The principal results as applying to the cases before us are the following:—

First, as regards Distortion.

I must refer to page 15 of the Memoir for the general formula; but I may quote the following special results:—

(*a*.) It is possible to destroy Distortion entirely, but not by the use of common forms (equi-convex or plano-convex).

(*b*.) The most favourable combination of common lenses is,— the first, equi-convex; the second, plano-convex, with its convex side toward the first lens, or with its plane side next the eye.

Second, as regards Indistinctness at the edge of the field.

From the general formulæ in page 35 it appears that it is

impossible in any eye-piece whatever, in which the lenses are all convex, to secure distinctness in the approach to the edge of the field, except, in some cases, by movement of the eye-piece; and the problem always is to diminish the Indistinctness as much as possible. For this purpose, in the Huyghenian eye-piece,

(*c.*) The different points of the image may be made distinct by a little sliding of the eye-piece, by a form very nearly the same as the following:

(*d.*) The best form is, for the field-glass, a meniscus, with convex side towards the object-glass, and radii as 4 : 11; and for the eye-glass a convex lens, the mere convex side towards the field-glass, and radii as 1 : 6. The constants by which the indistinctness in the two dimensions is expressed are $\frac{95}{126}$ and $\frac{61}{126}$.

(*e.*) The best combination of common lenses is, two plano-convex-lenses, the plane sides of both towards the eye. The constants of indistinctness then are $\frac{133}{126}$ and $\frac{175}{126}$.

(*f.*) For a single lens to produce the same power, the smallest values of constants of indistinctness would be $\frac{196}{126}$ and $\frac{476}{126}$.

The following rule, though not strictly accurate, will be found sufficiently accurate to give a very good practical determination of the curvatures of all eye-piece lenses in all cases. Trace the course of an excentric pencil through the eye-piece. Consider separately the convergences, &c. of the axis of the pencil with regard to the axis of the telescope, and that of the rays of the pencil with regard to the axis of the pencil. When both these convergences fall on one side (as in the Huyghenian field-glass) the lens ought to be meniscus. When they are at equal distances on opposite sides, the lens ought to be equi-convex. When the convergence of either is much nearer (the other being on the opposite side), the side of the lens next it ought to be plane.

1862, *December* 10.

At the November Meeting the Astronomer Royal gave an interesting *vivâ voce* account of some investigations which have been recently made to improve our knowledge on the Measures of the Earth and of the Heavens.*

The first part of the Astronomer Royal's Address was

* I am indebted for this article to J. N. Lockyer, Esq., Fellow of the Society, who has kindly undertaken to supply reports of *vivâ voce* communications at the Meetings. — Ed.

illustrated by a map of Europe, on which had been inserted, by hand, the principal lines of triangulation of the countries already surveyed, and also the positions of several towns in Russia which had been obtained after the manner of a ship at sea. A glance at this map rendered evident the fact that the triangulation from the Danube to the North Cape on the North, and from the middle of Russia to Valentia Island on the West, left little to be desired.

Referring to the first labours of the French in the last century, and those of the French, Russians, and Swedes in the present century for the measures of different *Arcs of Meridian*, the Astronomer Royal observed that Russia has taken the lead in the geodetical operations at present in question—the measurement of an *Arc of Parallel.*

This arc, extending from Valentia on the West to the town of Orsk, situated in the extreme East of European Russia, and in nearly the same latitude as Valentia, comprises nearly seventy degrees of longitude, and is, as remarked by the Astronomer Royal, perhaps the longest one that will ever be measured by man.

It was pointed out, by means of the map, that this project of the elder Struve's, which was warmly taken up by the different Governments, by no means required the measurement of the entire arc: the existing triangulation, extending (as before remarked) from Valentia to a point pretty well advanced, would only require linking together where gaps existed, and extending eastward to Orsk.

To derive the measure of the Earth from these operations, it was first necessary to find, by some lineal measure, the *length of this arc;* in other words, to find the *distance in yards* (our standard measurement) between Valentia and Orsk; and, secondly, *the difference of the local times* at the two stations.

First, as to the length of the arc. The British part of it required little attention, as (thanks to the admirable work of the Ordnance Surveyors and subsequent investigation) the actual distance from Valentia to Dover is certainly known to within a few yards. Unfortunately the distance from Dover to Paris (equally well known) will not serve us, Paris being too far south. It became necessary, therefore, to effect a junction with the continental triangulation at some more northerly point; and this has been admirably effected, during the present year, by Sir H. James.

The whole distance from Valentia to some station well advanced is by this time computed, while the triangulation itself is fast approaching Orsk.

Secondly, as to the differences of local time at Valentia and Orsk. This, in an arc of such magnitude, can only be obtained from the differences of local times at intermediate stations in the arc; as, for instance, between Valentia and

Greenwich, Greenwich and Brussels, &c.; and in these determinations, as suggested by the illustrious projector of the operations, railways and telegraphs must be freely taken advantage of.

The difference of local times at Valentia and Greenwich was, as is well known, the subject of elaborate inquiry, some years ago, when several transmissions of chronometers were undertaken between the two places. The results obtained on this occasion have recently been confirmed in a remarkable manner, a complete electric circuit between the two places having been placed at the disposal of the Astronomer Royal by Sir Charles Bright. The difference of times obtained by the electric current (which, it may be stated *en passant*, took one-tenth of a second to traverse the 800 miles of wire) *agreed exactly* with that obtained from the chronometric expedition.

The second part of the Address related to the dimensions of the Solar System.

The recent researches into the velocity of light by means of the turning mirror — an instrument which, as used by M. Foucault, renders this velocity, inconceivable though it be, measurable by a cabinet experiment — and the parallax observations of *Mars*, which have been made during the autumn of this year in both hemispheres, were alluded to by the Astronomer Royal as affecting the determination of the Sun's distance, the unit of all measures of the Heavens.

The smaller velocity of light announced by M. Foucault was shown to necessitate a decrement of the Sun's distance, the two being connected by aberration; for as the umbrella of him who is caught in a shower inclines to meet the rain at a certain angle which depends upon the relative velocity of the rain-drops and the rate at which he is walking, so does the telescope point in advance of the star at a certain angle dependent upon the relative velocities of the light which enters it and the Earth which carries it.

This angle shows that the Earth travels (speaking in round numbers) 10,000 times more slowly than light. If, therefore, it is established that the received velocity of light must be diminished, the diameter of the Earth's orbit, which satisfies the received velocity, must be decreased in the same proportion.

The Sun's parallax, $8''{\cdot}5776$, deduced from the transits of *Venus* in 1761 and 1769, has also been called in question by M. Le Verrier, on other considerations; and the extreme doubtfulness of some of the most important observations of the transit of 1769 renders the success of those of the planet *Mars* doubly desirable; and although, by the latter method, the Sun's distance is only *indirectly* obtained (that of *Mars* resulting *directly* from the observations), the distances are bound together by a proportion which, as remarked by the

Astronomer Royal, was accurately known in the times of Copernicus and Tycho as at present.

There is reason to hope that the attempt of the present year will be attended with success. A fair number of eastern and western observations for the independent determinations have been obtained at Greenwich, and more are expected from Madras and Williamstown; and the meridian observations of Polar Distance (which require the co-operation of northern and southern observers) have been undertaken with vigour at all the Observatories of both hemispheres.

The Astronomer Royal also exhibited an original drawing of the fringes of light formed on a wall immediately before the disappearance of the Sun in the Total Eclipse of 1861, Dec. 31, prepared by a French officer, M. Poulain, Capitaine du Génie, at Goree.

In the accounts of the Eclipse of 1842 collected by M. Arago, and in those of the observers of later eclipses, it has been stated that in the last seconds before total obscuration there is a strange quivering of light upon the ground, &c., like the flitting of small shadows. The Astronomer Royal, in returning from his observing-station in Spain after the Total Eclipse of 1860, July 18, was accompanied in one journey by our Medallist, M. Goldschmidt (an excellent linguist), and by a Spanish gentleman who had observed the eclipse without instruments. This gentleman had been much struck by the sight of the flitting shadows; but, in the conversation which the Astronomer Royal held with him through the interpretation of M. Goldschmidt, it did not appear that the observations were made with such accuracy as to give useful information on the phenomenon.

On the occasion of the Total Eclipse of 1861, Dec. 31, M. Poulain, Capitaine du Génie in the French army, found himself at Goree, with the charge of observing the eclipse if possible; but without telescope or other instruments of the slightest accuracy. With great judgment, he applied himself to make the best use in his power of the means at hand. Meteorological observations of several classes were made with care, and recorded in a most orderly form; on these, however, the Astronomer Royal did not then insist, but proceeded to the depiction of the fringes, which M. Poulain had very carefully observed. The Sun was shining on a vertical white wall directed from east to west, and on this wall, a very short time before the totality (*un instant avant l'occultation*), the fringes were seen; and they were subsequently drawn by M. Poulain in their exact size (*en vrai grandeur*) on the sheet then exhibited. The only account of them given in the detailed record

is, "On voit des franges noires se dessiner sur le mur qui borde notre terrasse." The drawing exhibits five bands; three white, and two dusky-dark, each 4 inches broad; and their form seems to imply that in the longitudinal direction their length was considerable, and that in the lateral direction the repetition was more frequent. Their inclination to the vertical is about 45°; the right-hand end, referred to the hand of a person who is looking at the wall with his back to the Sun, being the lower.

At the Astronomer Royal's request, Mr. Hind was so good as to calculate the position of that point of the Sun's disk which was the last to disappear. It was at 31° from the Sun's vertex towards the east, or towards the left hand of an observer whose face was turned to the Sun. On comparing this with the position of the fringes, as depicted by M. Poulain, and referring the latter roughly to the direction of the Sun's rays, it appears that we may state, with as great accuracy as the observation permits, that the length of the fringes was in the same plane as the tangent to the disks of the Sun and Moon at the place of last disappearance.

The first impression from these appearances is, that they are diffraction-fringes; but the possibility of this explanation would seem to be destroyed by the consideration that any diffraction-fringes must travel with a linear velocity equal to the Moon's linear velocity, and must therefore be totally invisible. The phenomenon is one which deserves the careful attention of observers and optical philosophers. Meantime we may congratulate ourselves that we have for the first time a representation of this singular appearance aspiring to the character of reasonable accuracy. G. B. A.

Extract of a Letter from Herr A. Auwers to the Astronomer Royal, dated 5, *Gartenstrasse, Gotha*, 1861, *December* 1. —(Translation.)

Perhaps it is not uninteresting to you to know the result of researches on Parallaxes [of Stars] which I have carried out during the last two years at Königsberg. It is known that Struve, from observations with the Pulkowa Refractor for the parallel of 61 *Cygni*, has obtained a much larger value than Bessel had found with the Königsberg Heliometer, namely, $0''{\cdot}5107 \pm 0''{\cdot}0282$, instead of $0''{\cdot}366 \pm 0''{\cdot}012$. For that reason, I have effected a new determination with the Heliometer, in which I have made use of two comparison-stars different from those used by Bessel, which permit the application of the principle of differences in the most direct manner possible.

From observations on 62 days between 1860 September and 1862 June, I have obtained

Parallax of 61 Cygni = + 0″·5656 ± 0″·0158.

The difference of this determination from Struve's is scarcely greater than its mean error. The mean from both is,

Parallax of 61 Cygni = + 0″·5526 ± 0″·0138;

greater than Bessel's determination by 0″·19.

Another star whose parallax I have determined is the star with large proper motion lately discovered by Prof. Argelander, namely, Lalande 21258. This star (of the 8.9 magnitude) I have compared on 64 days, from 1860 November to 1862 June, by means of the Heliometer, with one star (of the 8 magnitude) preceding it by $4^m\ 11^s$ and with one star (of the 9 magnitude) following it by $3^m\ 56^s$; and from the differences of observed distances I have found

Parallax of Lalande 21258 = + 0″·2622 ± 0″·0109,

relative to the mean of the two comparison-stars; or absolutely, in conformity with the determinations of Professor Peters,

Parallax of Lalande 21258 = + 0″·2709 ± 0″·0112.

[*Note by the Astronomer Royal.*—The proportion of the discordance of the determinations of the same element, by different observers, to the magnitude of the probable error which each has assigned, throws great doubt upon the validity of such determinations of probable error.]

In a letter, dated Dublin, Nov. 12, 1862, Mr. Stothard notices the extraordinary brightness of *Aristarchus*, seen by him as a bright speck on the Moon's disk, that morning about $10^h\ 30^m$ A.M. Mean Dublin Time, in bright sunlight.

Mr. Grove, in a letter, dated Upper Harley Street, 5 Nov. 1862, gives an account (illustrated by three pencil sketches) of the appearances presented by the planet *Mars* on Oct. 26 and 31, and Nov. 3: the telescope used was $4\frac{1}{2}$ inches aperture; focal length 6 feet 2 inches; object-glass by Cooke, of York, capable of dividing *γ Coronæ*. He is perfectly satisfied of there being notable changes in the distribution of the lights and shadows, inconsistent, it appears to him, their being land and water, or, as he should perhaps say, land and water *only:*

clouds condensed over large aqueous districts might possibly account for the changes observed; the changes of position by axial revolution would not explain them.

A paper has been received from Prof. A. D. Wackerbarth, "On the Motion of a Pendulum with especial reference to the Foucaultian Experiments." The greater part of the paper is occupied in the investigation of the equations of motion, which are carefully and elegantly worked out; but the integration of them is developed only so far as to give the ordinary approximate result of a rotation of the plane of oscillation, with a velocity proportional to the sine of the latitude.

A paper by Mr. Wray, "Observations on *Saturn*," will be published in the following Number of the *Monthly Notices*.—Ed.

In a letter dated Hamilton College Observatory, Clinton, N. Y., 1862, Nov. 24, addressed to the Astronomer Royal, Dr. C. H. F. Peters gives, for Minor Planet (71) *Feronia*, the following elements, which are slightly different from those communicated to the *Ast. Nach.* (under the date Nov. 12, see No. 1396):—

Epoch 1862, Dec. 31·0 Greenwich M.T.

M_0	=	73° 4′ 56″·48	
π	=	309 48 37·93	Mean Eq. 1863·0.
Ω	=	207 37 13·11	
i	=	5 25 55·22	
φ	=	6 41 17·06	
μ	=	1034″·0617	
Log μ	=	3·0145464	
Log a	=	0·3569735	

(The planet 12-11th magnitude.)

And he gives notice of another new asteroid, which he saw first 12th November and last 23d November; on both which evenings, however, it was clear only for so short a time that he could not determine the position accurately. A good observation (the only one then obtained) was

	H. C. Mean Time.	R.A.	Decl.	
Nov. 15	$7^h\,26^m\,30^s\cdot3$	$0^h\,2^m\,8^s\cdot93$	$+\,1°\,27'\,12''\cdot2$	(6 comp.)

The magnitude of the planet was about 11·7. The places on the other days mentioned differed from that of the 15th about thus:—

	s		′	″	
Nov. 12	0·6	less in R.A.	1	49	further South.
,, 23	19	more in R.A.	21	40	further North.

these motions being taken only by measurement from the chart.

Comets III. and IV. 1862.

(*Letter from Dr. Bruhns.*)

"*Leipzig, 6 Décembre*, 1862.

"Je me permets de vous envoyer des éléments et des éphémérides des deux comètes qui peuvent servir à faciliter leur observation. Les éléments de la première comète sont calculés par M. Engelmann au moyen des observations des 1, 2, et 3 Décembre, ceux de la 2e comète par moi-même au moyen des observations des 1, 2, et 4 Décembre.

	Eléments de la 1e Comète (Mouvement rétrograde).	Eléments de la 2e Comète (Mouvement rétrograde).	
	Temps de Berl.	Temps de Berl.	
Passage au Périhélie	1863, Fév. 1·708	1862, Déc. 31·1959	
	° ′	° ′ ″	
Longitude du Périhélie	34 18·5	128 12 55·3	Equinoxe 1863·0.
,, du Noeud	114 31·0	358 16 11·5	
Inclinaison ...	86 59·5	48 22 23·3	
Log. de la Dist. Périhélie	9·85124	9·935674	

Ephéméride de la 1e *Comète pour* 0h *Temps Moyen de Berlin.*

	R.A.	Decl.	Log Δ.	Eclat.
	° ′	° ′		
1862, Nov. 30	157 39·8	− 3 19·2	0·0124	1
Déc. 4	160 39·0	− 1 33·0	9·9601	,,
8	164 16·9	+ 0 48·1	9·9021	1·7
12	168 54·8	+ 4 1·0	9·8378	,,
16	175 4·6	+ 8 26·8	9·7676	3·1
20	182 30·7	+14 32·9	9·6945	,,
24	196 14·7	+22 27·1	9·6296	5·8
28	214 15·3	+31 0·0	9·5912	,,
1863, Jan. 1	236 48·9	+36 56·9	9·5980	6·7
28	305 30·6	+23 51·2	9·9995	1·1

Ephéméride de la 2e Comète pour 0h Temps Moyen de Berlin.

	R.A.	Decl.	Log Δ.	Eclat.
	h m s	° ′ ″		
1862, Nov. 30	13 52 59·9	−12 56 4	0·2153	1
Déc. 4	13 57 13·6	−15 39 7	0·1853	„
8	14 1 29·7	−18 48 4	0·1520	1·5
12	14 5 50·1	−22 58 4	0·1068	„
16	14 10 18·1	−26 55 5	0·0750	2·5
20	14 14 58·8	−32 17 7	0·0314	„
24	14 20 2·5	−38 54 3	9·9854	4·0
28	14 25 49·8	−47 3 8	9·9394	„
1863, Jan. 1	14 32 13·0	−57 0 7	9·8975	6·2
28	15 31 1·6	−45 25 6	0·0043	2·8
Fév. 17	20 7 7·2	−24 40 8	0·2091	0·8

" Tandis que la première comète sera visible dans nos observatoires boréals, l'autre disparait déja au milieu de Décembre par suite de sa déclinaison australe, mais elle va reparaître probablement au milieu de Février."

A few Notes on Prof. C. P. Smyth's Experiences with the Elchies Refractor. By the Rev. W. R. Dawes.

In the interesting account given by Professor C. Piazzi Smyth in the *Monthly Notices* for November last of his " Experiences with the Elchies equatoreally mounted Refractor of 11 inches aperture," he refers to a group of stars, of which P. i. 222, is the brightest, as having very surprisingly varied in their magnitudes since they were measured by his Father in 1834, in whose " Cycle " they form No. 78. This led me to give them an early examination; and I was astonished to find that no perceptible variation had taken place. On comparing the object presented to my view in my $8\frac{1}{4}$-inch refractor, with a power of only 94, with the Professor's account of it and with Admiral Smyth's measures, I immediately perceived that the Elchies Refractor had not shown the star B at all!—which is the more surprising as it was obvious enough in my telescope at the first glance with so low a power. Moreover, in the " Cycle " there is a transposition of the magnitudes and colours of A and D,—the latter being P. i. 222, a star rather below the 6th magnitude. This mistake, combined with the absence of B in his telescope, has led the Professor to surmise a total change in the group. The three stars to the south of P. i. 222, form the triple star Σ 196; and the fol-

lowing comparison of magnitudes, position, and distances will show that all the components are *in statu quo*:—

Σ 196; $\alpha = 1^h\ 51^m\ 59^s{\cdot}5$; $\delta = +2c^\circ\ 20'\ 32''$; Epoch 1863·c.

	Magnitudes.				Positions.					Distances.			
	Σ.	Sm.	*Sm.*	D.		Σ.	Sm.	*Sm.*	D.	Σ.	Sm.	*Sm.*	D.
A	8½	9	12	9									
B	11	15	not seen	10½	AB	55°·53..	53°·0..	... ..	53°·7	2″·37..	2″·5..	... ..	2¾″ ±
C	9¼	10	12	9½	AC	167·38..	165·0..	169·25..	165·6	39·46..	40·0..	36·94..	36·2±
D	...	6	7½	6¼	AD	...	..359·2..	360·35..	361·6	...	..165·0..	880·54..	182·5±

My positions and distances were only single measures with a very low power, for the sake of certain identification. Struve has not included the bright star D, which is, in fact, too distant to belong properly to the object he measured. How it should have happened that, though the group was so carefully examined with the Elchies Refractor, that fine instrument failed to show the star B, remains to be explained; for it certainly ought to be obvious enough in such a glass. It is an important fact, however, as showing how unsafe it is, because an object was not seen when it might have been supposed that it could not possibly have escaped observation, to conclude from this that it must therefore be variable in brightness.

With reference to the visibility of such very minute stars as are many of those which are adduced in proof of the optical power of the Elchies Refractor, it would, I think, be a great mistake to assume as certain, or even as very probable, that, because the existence of such minute specks, at a distance of one or two minutes, is not recorded, *therefore* they were not seen; and it would be a still greater mistake to assume that they *could not* have been seen, or even micrometrically measured, with the instruments in use, if the design of the observers had been to test the optical powers of their telescopes. For instance: as the group round P. xxi. 312, contains some of the smallest stars quoted as discovered by the Elchies Refractor, I turned my telescope upon it; and though the night was rather hazy and the star nearly four hours from the meridian, all the stars seen at Elchies were brought out without the slightest difficulty with power 94, except C, which, being pretty near the brightest star, required a higher power to draw it out.

The most valuable property in a telescope is undoubtedly a *fine sharp definition;* and wherever this exists, even in an ordinary degree, a very simple calculation will show of what magnitude a star must be to be visible with any given aperture. Thus an object-glass of 11 inches in diameter will show a star whose magnitude is about 12¼ of Struve's scale, or 18½ of Sir John Herschel's. Nor is the visibility of such a star, when *isolated*, greatly affected by the quality of the object-glass, unless very bad indeed; but it is far otherwise when a very

small star is within 2″ of one much brighter than itself; for then the visibility of the small star will chiefly depend on the fine definition of the brighter.

As there are now so many large telescopes, both refractors and reflectors, in existence and in process of manufacture, I hope soon to present to the Society a list of objects most suitable for severely testing their powers of definition, and well situated for observation in this latitude.

Hopefield Observatory, Haddenham, near Thame,
Dec. 10, 1862.

RECENT PUBLICATIONS.

The Earth and its Mechanism; being an Account of the various Proofs of the Rotation of the Earth: with a Description of the Instruments used in the Experimental Demonstrations. To which is added, the Theory of Foucault's Pendulum and Gyroscope. By H. Worms, Esq., F.R.A.S., F.G.S. London, 1862.

The work is intended as a complete collection of the various demonstrations of the Earth's Rotation, and the theorems connected therewith; the principal object being to promulgate a knowledge of the more recent discoveries and experiments relating to this branch of science. Thus particular attention is drawn to Arago's application of Wheatstone's revolving mirror for the measurement of the velocity of light. A minute account is given of the latest experiments on falling bodies, made by Prof. Reich in the mines at Freiberg, in addition to those of Benzenberg and Guglielmini; the phenomena exhibited by Foucault's pendulum and gyroscope are carefully explained, &c. The second part, intended for the perusal of the mathematical student, gives, from Hansen's *Theorie der Pendelbewegung* (Danzig, 1853), with some omissions and additions, an investigation of this dynamical problem of the motion of a pendulum as affected by the rotation of the Earth.

Annals of the Astronomical Observatory of Harvard College, Vol. III., Cambridge (U. S.), 1862.

The volume has the second title, "Account of the Great Comet of 1858, by G. P. Bond, Director of the Observatory of Harvard College."

The following list of the titles of the several sections will give an idea of the contents of this splendid Monograph of Donati's Comet: —

I. Figure and Position of the Tail. — Comprising the original notes of observation upon the principal tail, between August 14th, 1858, and February 9th, 1859, quoted with full references to the original authorities, and accompanied by remarks indicating the principal points of interest. This section is illustrated by twenty-three engravings, on steel, of the appearance of the Comet to the naked eye, and by eight wood-cuts.

II. Observations upon the Secondary Tails.—The text is illustrated by three wood-cuts, and by the engravings and charts of the naked-eye views.

III. Reduction of Observations upon the Figure and Position of the Tail. — The results of the discussion are exhibited on a series of charts giving the normal outlines of the principal tail on twenty-eight dates, between September 16th and October 17th inclusive, and the axis of the principal secondary tail for seventeen dates.

IV. Probable Errors of Observations upon the Tail.

V. On the Deflexion of the Tail.—Describing a peculiarity in its upper regions during the first and part of the second week in October. Two plates of outlines and a wood-cut accompany the text.

VI. Columnar Structure of the Tail. — Relating to a remarkable feature faintly exhibited in the upper part of the tail.

VII. Reduction of Observations on the Secondary Tails.— The results of this discussion have been entered on the charts, with the outlines of the principal tail.

VIII. The Nucleus and Envelopes.—The original accounts descriptive of the telescopic appearance of the Comet are here quoted in the same form as in Section I. They are accompanied by twenty steel engravings.

IX. On the Outline of the Head of the Comet. — The discussion is illustrated by two plates, showing the normal outlines of the head of the Comet between Sept. 3d and Oct. 18th.

X. On the Branches and Central Darkness of the Tail.— Engravings of nine views of the Comet, 1860, III. are given in this Section.

XI. The Nucleus. — Containing a description of the nucleus, with particular reference to its size and changes of brightness.

XII. The Envelopes. — The various phenomena of the envelopes, their velocity of ascent, the dark and bright spots on their surface, and the question of their rotation or oscillation, are considered in this Section, which is illustrated by a lithographic plate of 138 telescopic views. The Section concludes with a notice of the envelope formation in the

Comet, 1860, III. and in the great Comet, 1861, II. accompanied by a steel engraving of the former.

XIII. The Outer Faint Veil. — Containing an account of this feature, with a reference to a similar peculiarity in the Comet, 1860, III.

XIV. On the Direction of the Initial Axis of the Tail.

XV. Conclusion. — This Section gives a general summary of the contents of the volume.

The naked-eye and telescopic views of the Comet, shown on a dark ground, are very beautiful specimens of steel engraving.

P. A. Hansen, Darlegung der theoretischen Berechnung der in den Mondtafeln angewandten Störungen; Erste Abhandlung. Leipzig, 1862. (forms part of t. vii. of the *Abhandlungen der mathematisch-physischen Classe der Königlich. Sächsischen Gesellschaft der Wissenschaften*, pp. 93–497.)

In this elaborate memoir — the first part of the anxiously expected Theory of Prof. Hansen's Lunar Tables — the perturbations in longitude are completely calculated; but of the perturbations of the latitude and radius vector respectively, only the portion which the author designates as the principal one. The method employed is stated to be with a slight variation that explained in the *Fundamenta Nova Investigationis orbitæ veræ quam Luna perlustrat*, the demonstration of the fundamental formulæ is however given *de novo*. It is hardly necessary to mention that the numerical values of the coefficients are substituted in the first instance in the formulæ, and the multiplications and integrations carried out numerically. The author has compared his values of the perturbations of the longitude with those of Plana and Damoiseau, the differences being in some instances not inconsiderable; but he has not as yet made the comparison with those of Delaunay. At the conclusion of the memoir the author investigates the perturbations which depend on the figure of the Earth, and the mass and figure of the Moon.

Nouvelles Recherches sur la Figure des Atmosphères des Corps Célestes. Par M. Edouard Roche. 4to, Paris, 1862. (Extrait des Mémoires de l'Académie de Montpellier, Section des Sciences, 1862.)

The present Memoir is a sequel to one published in the year 1854. The author, on the suggestion of M. Faye, has

since introduced into his calculations the hypothesis of a repulsion exerted by the Sun on the Cometary Atmosphere; the repulsion is assumed to act in the direction of the radius vector, and to vary as the inverse square of the distance from the Sun; but the intensity is supposed to depend on the matter operated upon, viz. that, while nothing for the nucleus, it becomes sensible or even considerable for the exceedingly rare atmosphere of the Comet.

The equation of the *couche de niveau* or level surface (which is of course a surface of revolution about the Sun's radius vector) is obtained in polar co-ordinates in a very simple form; for sufficiently small values of the parameter which determines the particular surface, the section of the surface is a sort of oval, elongated however on the side away from the Sun. Geometrically, however, there is a detached infinite branch of the section; and, when the parameter acquires a certain limiting value, the two branches unite together so as to form a curve with a double point on the side opposite the Sun; the *surface* has then a conical point. The physical conclusion is, that as soon as we come to this limiting form of the level surface, the atmosphere, instead of continuing to form finite envelopes surrounding the nucleus on all sides, will, so to speak, flow out through the conical point of the surface, and so give rise to a tail. Want of space prevents the giving a more complete account of this very interesting investigation.

Instrument to be disposed of.

A Fraunhofer Equatoreal, with Circles read by two sets of Verniers to 4^s and $1'$, in good order. Inquiries to be addressed to the Assistant Secretary.

ERRATUM.

Vol. XXIII., page 16, heading of Table C, *for* "in the year 1861," *read*, "the years 1854 to 1860."

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